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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/016,896	12/13/2001	Yu-Chi Sun	B-4418 619378-8	9624

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EXAMINER	
NGUYEN, THANH T	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 10/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/016,896	Applicant(s) SUN ET AL.	
	Examiner Thanh T. Nguyen	Art Unit 2813	AU

-- The MAILING DATE of this communication appears on the cov r sheet with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 August 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 1-22 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-7, 9-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang (U.S. Patent Application Publication No. 2002/0045353 A1) in view of Kim et al. (U.S. Patent No. 6,316,349), and further in view of Thei et al. (U.S. Patent No. 6,335,249).

Referring to figures 1-2B, Kang teaches a method of forming a self-aligned contact hole suitable for a semiconductor substrate having a pair of gate electrodes (52) comprising the steps of:

Forming a nitride etching stop layer (54, called "etch barrier" in Kang, see figure 2a, paragraph# 35) over the gate electrode (52, see figure 2a) and the semiconductor substrate (50, see figure 2a),

Forming an oxide insulating layer (56, see figure 2a, paragraph# 33-34) on the nitride (54), and

Plasma-etching the oxide-insulating layer (59, called "dry etching" and is a plasma in Kang, see paragraph# 35-36) by etching gas consisting C_4F_6 and CHF_3 or C_5F_8 and CHF_3 when n=4 or 5 and Ar so as to form a self-aligned contact hole (SAC, see figure 2a, paragraph# 36, and claims 1, 3-7) between the pair of gate electrode (52, meeting claims 1, 9, and 16).

Regarding to claims 2, 10, and 17, the oxide-insulating layer is BPSG (see paragraph# 26).

Regarding to claims 4, 12, and 19, the nitride etching stop layer is silicon nitride (see paragraph# 33).

Regarding to claims 6, 14, and 21, the etching gas further comprises an inert gas (called "noble/rare gas" in Kang, see paragraph# 31).

Regarding to claims 7, 15, and 22, the inert gas is argon gas (see paragraph# 31).

Noted that it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made that using the same etchants C_4F_6 and CHF_3 or C_5F_8 and CHF_3 when n=4 or 5 and Ar so as to form a self-aligned contact hole (SAC, see figure 2a, paragraphs# 30, 36) to etch the same material would provide the equalizing the etching rate to the etching stop layer at the top corner and the bottom of the contact hole (see figures 2a-2b).

It is held, absent evidence to the contrary that cooling (decreasing) the temperature of the layer after annealing in order to facilitate handling. *See* In re Best, 195 USPQ 428 (CCPA 1977) and In re Fitzgerald, 205 USPQ 594 (CCPA 1980).

Kang teaches a method of forming a self-aligned contact hole by etching the silicon oxide layer using $C_5F_8/CHF_3/Ar$, but fail to teach forming an oxide insulating layer by using a reactive gas containing TEOS. Nevertheless, forming an oxide insulating layer by using a reactive gas containing TEOS is known in the semiconductor processing art as evidenced by Kim et al.. Kim et al. teaches Forming a nitride etching stop layer (57, called "etch barrier" in Kim et al., see figure 5, col. 8, lines 18-21) over the gate electrode (53, see figure 5, col. 8, line 14) and the semiconductor substrate (51, see figure 5, col. 8, line 47), forming oxide insulating layer by using a reactive gas containing TEOS (see figure 6, col. 8, lines 40-42) on the nitride etching stop layer (57, see figure 7, col. 8, lines 49-52), and Plasma-etching the oxide-insulating layer (59, called "dry etching" and is a plasma in Kim et al., see col. 15, line 34) by etching gas containing C_4F_6 and CHF_3 or C_5F_8 and CHF_3 when n=4 or 5 so as to form a self-aligned contact hole (SAC, see figure 7, col. 8, lines 1-2, and col. 9, lines 15-21) between the pair of gate electrode (53, meeting claims 1, 9, and 16).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form an oxide insulating layer by using a reactive gas containing TEOS in process of Kang as taught by Kim because the process would the material would provide the planar surface and also determining the optimum material for the layer only involved routine skill in the art.

Kang also fails to teach forming an etch stop layer of oxidized silicon-rich nitride layer (57) can be silicon oxy-nitride. Nevertheless, forming an etch stop layer of silicon oxy-nitride is known in semiconductor processing art as evidenced by Thei et al.. Thei et al. teach a method of forming a self-aligned contact hole (2, see figure 1), forming a gate electrode (16, see col. 1, line

60), forming an etch stop/barrier layer such as silicon oxy-nitride (24, SiON, see figure 1, col. 2, lines 18-20) over the gate electrode (16), forming a interlevel dielectric layer (28, BPSG, see col. 2, lines 20-23), plasma etching the layers to form the opening (2, see figure 1, col. 2, lines 24-26).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made would form an etch stop layer of oxynitride in process of Kang and recognized Kang's oxidized silicon-rich nitride layer having Si-O, Si-Si bond and SiN bond can be an oxynitride layer (SiON) as taught by Thei et al. ***because*** forming an etch stop layer such silicon oxy-nitride would increase the etching selectivity of oxide layer to silicon oxy-nitride layer during the formation of a self-aligned contact hole, so that plasma etching would not etch the gate electrode.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over (U.S. Patent Application Publication No. 2002/0045353 A1) in view of Thei et al. (U.S. Patent No. 6,335,249), and further in view of Pall et al. (U.S. Patent No. 6,337,244).

Kang teaches a method of forming a self-aligned contact hole by etching the silicon oxide layer using $C_5F_8/CHF_3/Ar$, but fail to teach the specific C_5F_8/CHF_3 mixture ratio of the etching gas that is between 0.4-0.75. Nevertheless, using C_5F_8/CHF_3 mixture ratio of etching gas that is between 0.4-0.75 to etch oxide layer as evidenced by Pall et al. Pall et al. teaches forming a self-aligned contact hole using mixture of C_5F_8/CHF_3 gas at ratio of between about 0.2-5 (see Pall's claims 6, 39 and col. 6, lines 27-35 and col. 8, lines 1-14).

It has been held that when the general condition of a claim are disclosed in the prior art that it is not inventive to discover the optimum or workable ranges (*see In re Aller 105 USPQ 233* (CCPA 1955)) and further that optimization of known result effective variables is obvious *(see In re Antonie 559 F.2d 618,* 195 USPQ 6 (CCPPA 1977)).

Therefore, it would have been obvious to a person of ordinary skill in the art would use a mixtures of C_5F_8/CHF_3 gas with ratio of 0.4-0.75 to etch an self-aligned contact hole in the process of Kang et al. because the higher the etching selectivity of silicon oxide to silicon nitride layer would prevent over etching on the gate electrode.

Response to Arguments

Applicant's arguments with respect to claims 1-22 have been considered but are moot in view of the new ground(s) of rejection.

Applicant contends that Kang does not teach etching gas using octafluorobutene. In response to applicant that Kang clearly teach a mixture of etching gases of octofluorobutene with CHF_3 (see paragraphs# 30, 36, claims 1-5).

Applicant contends that Kim does not teach etching gas containing C_4F_6 and CHF_3 or C_5F_8 and CHF_3 or C_nF_{2n-2} and CHF_3 wherein n=4 or 5. In response to applicant that Kang teaches etching gas containing C_4F_6 and CHF_3 or C_5F_8 and CHF_3 or C_nF_{2n-2} and CHF_3 wherein n=4 or 5 (see paragraphs# 30, 36, claims 1-5) while relies on Kim to teach forming an oxide insulating layer by using a reactive gas containing TEOS.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (703) 308-9439, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:30AM to 4:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (703) 308-4940. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (**See MPEP 203.08**).

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN